

From Reaction to Resilience: Accelerating Innovation Across Europe's Critical Infrastructures

Major crises often trigger rapid announcements, but sustained delivery is where transformation truly succeeds. Europe's critical infrastructures, transport, rail, energy, digital, require faster innovation cycles and shared risk governance.

This paper argues for a holistic public–industry approach focused on scalability, modularity, and strategic coherence. Competitiveness and resilience in the next decade will depend on our ability to move from intent to implementation at speed

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We have witnessed many situations in which a triggering event mobilized public opinion, accelerated political reaction, and led to the rapid launch of new implementation programs. The collapse of the Ponte Morandi in Italy was,

however, a unique case: reconstruction proceeded with exceptional speed and determination.

In most other cases, the pattern is different. Under strong public and media pressure, initiatives are launched quickly. Yet soon after, bureaucratic constraints, limited risk-management capacity, fragmented decision-making, or external lobbying and political influences slow the process — sometimes to the point of paralysis.

For many years, the relationship between public administrations and the industrial system followed a relatively stable and predictable rhythm: multiannual planning, calls for tender, technological development, and eventual implementation. Today, this model is no longer sufficient.

In a context shaped by global technological competition, the energy transition, accelerated digitalisation, and the fragility of supply chains, the broader challenge for any national system, particularly within the European Union, is to

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increase the speed of transformation without losing strategic coherence.

This is not simply about “doing more innovation.” It is about ensuring the rapid and concrete deployment of developed solutions. The speed at which a technology moves from pilot phase to large-scale adoption has become a decisive competitive factor.

A Structural Change

The transformations underway are profound:

- Global competition for critical raw materials and strategic components (microelectronics, batteries, advanced materials).
- The growing centrality of digital technologies and artificial intelligence in industrial and infrastructure systems.
- Increased exposure of supply chains to geopolitical and logistical shocks.
- Innovation is increasingly originating in the private sector and startups, operating at cycles much faster than traditional administrative processes.

These dynamics directly affect Europe’s critical infrastructures — including transport corridors under the Trans-European Transport Network, high-speed rail systems managed by entities such as Rete Ferroviaria Italiana, major hubs like Deutsche Bahn, and urban mobility systems in cities such as Paris or Berlin.

Energy grids, ports, airports, railways, and digital backbone networks are no longer static assets; they are dynamic, data-driven systems that require continuous technological upgrading.

In this environment, linear and rigidly sequential funding and procurement models reveal clear limitations.

The “Transition Gap”

One of the main problems is not the ability to generate ideas or prototypes, but the difficulty of transforming them into operational and scalable solutions.

Many technologies prove their validity in laboratories or pilot environments. However, they encounter obstacles during industrialisation and diffusion: regulatory uncertainty, lack of stable demand,

fragmented responsibilities, and limited access to capital.

This “transition gap” is often where innovation slows down or dissipates — even in sectors vital to European resilience, such as smart rail signalling, cybersecurity for energy networks, or intelligent traffic management systems.

The Need for a Holistic Approach

Bridging this gap requires a holistic approach that integrates:

- Industrial policy
- Financial instruments
- Technical regulation and standardisation
- Public procurement
- Skills and workforce development policies
- Supply chain security and resilience

A public contracting authority cannot limit itself to supporting research. It must accompany the entire innovation lifecycle, from development to full integration into productive systems and public services.

This is especially true for EU critical infrastructures, where technological upgrades affect not only efficiency but also safety, sustainability, and systemic resilience.

From a technological perspective, promoting modular and open architectures is essential. Systems designed for interoperability and upgradability allow:

- Integration of new solutions without rebuilding entire infrastructures;
- Reduced upgrade costs;
- Easier market entry for innovative actors;
- Mitigation of technological dependency risks.

This principle applies to smart energy grids, digital infrastructure, railway control systems, data platforms, and intelligent mobility networks. In certain domains, these solutions may have dual-use implications, but the primary objective remains civil competitiveness and infrastructure resilience.

Sharing Responsibilities and Risks

A central issue is the balanced redistribution of responsibilities and risks between the public and private sectors.

Traditionally, public authorities define rigid requirements and transfer most technical and financial risks to industry. This model tends to discourage innovation and slow the adoption of new solutions.

A more modern framework includes:

- Early-stage co-development between administrations and companies;
- Regulatory sandboxes to reduce uncertainty;
- Financial instruments that share risk during scaling phases;
- Performance-oriented contracts rather than purely compliance-driven procurement.

Risk-sharing does not mean lowering standards. It means aligning incentives. When public and private actors share objectives, timelines, and responsibilities, the probability of successful implementation increases — particularly in complex infrastructure environments.

Evolution of Client–Supplier Relationship

Public demand can play a decisive role in creating markets for emerging technologies. Clear and predictable demand signals enable companies to invest in production capacity, skills, and national supply chains.

In sectors such as energy, digital infrastructure, cybersecurity, sustainable mobility, and rail modernisation, this leverage strengthens both economic competitiveness and overall resilience. In some areas, the benefits extend indirectly to dual-use capabilities, reinforcing broader strategic stability.

The relationship between contracting authorities and industry must evolve from a purely transactional logic to a strategic partnership.

The objective is not merely to purchase solutions, but to build an industrial ecosystem that is:

- Resilient
- Innovative
- Rapidly adaptable
- Competitive in international markets

In this sense, the national industrial base becomes not only an economic asset but also a pillar of systemic stability.

The Real Challenge

The fundamental question is not whether adequate technologies exist. It is whether institutional systems can operate at the same speed as the global technological environment. Speed, coordination, shared responsibility, and intelligent risk management are now decisive factors.

The competitiveness of the next decade will depend on the ability of ministries, infrastructure operators, and industry **to function as an integrated, coherent, and adaptive system, capable of transforming innovation into concrete capability at scale.**